

Part 1. Report Cover

Retest Report Number: N/A

Retest Report Date(s): N/A

Replacement Report Number(s): N/A - new requirement

Original Report Number: 00AYP030

Original Report Date: 1 Mar 00

Revision Date(s): N/A

Title: Performance Oriented Packaging Testing of a
Grade V3c Fiberboard, Style RSC Box, 12 inches
by 12 inches by 12 inches (ID), With 1-Gallon,
Friction Plug (Lid), Round, Metal Can (Quantity of 1)
for Liquids

Responsible Individual: Francis S. Flynn

Performing Activity: LOGSA Packaging, Storage,
and Containerization Center
ATTN: AMXLS-T
11 Hap Arnold Boulevard
Tobyhanna, PA 18466-5097

Performing Activity's Reference(s): 9HTNR; AMC 13-88

Report Type: Interim Final

Requesting Organization:

Defense Logistics Agency
Defense Distribution Center
ATTN: DDC-TO
2001 Mission Drive
New Cumberland, PA 17070

Requesting Organization's Reference(s):

1. Memorandum from DLA, 14 Oct 99

Part 2. Test Results: ____ single X combination ____ composite

Section I. Pre-test Conditions

For initial testing, a bundle of boxes was received in new condition. Boxes from the lot from which this box was taken have also been performance tested with a variety of bottles and cans.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence.

<u>Specimen No.</u>	<u>Test</u>
A	repetitive-shock vibration test flat onto bottom, drop test flat onto top, drop test flat onto long side, drop test flat onto short side, drop test bottom joint corner, drop test stack test
B	water resistance test

Section II. Summary

	<u>SPECIMEN</u>	<u>ALL</u>
A. Drop test - 1.8 m (PG I SG 1.2, PG II SG 1.8, PG III SG 2.7)		PASS
flat onto the bottom (face 3)	PASS	
flat onto the top (face 1)	PASS	
flat onto long side (face 4)	PASS	
flat onto short side (face 6)	PASS	
bottom, joint corner (2-3-5)	PASS	
B. Stacking test - static load, 500 lb, 24 hr		PASS
C. Vibration standard - repetitive-shock, rotary motion 3.4 Hz., 1 hr		PASS
D. Leakproofness test - restrained under water/soap over seams		N/A
production testing, 20 kPa, 5 min.	N/A	
design qualification, 20 kPa, 5 min.	N/A	
salvage drum requirement, 20 kPa, 5 min.	N/A	
E. Internal pressure test/Hydrostatic pressure test (liq.) -		N/A
F. Water resistance test (fiberboard box) -		PASS
G. Compatibility test (liq. in plastics) -		N/A

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment. This report ~~is~~ is not applicable to transportation by air.

Part 2. Test Results (continued)**Section III. Discussion**

Note. Alpha designations denote which specimen tested in that orientation.

A. Drop test: 49 CFR §178.603

- ☐ cold conditioned (0° F, 72 hr)
☐ ambient conditions
☒ standard conditions (50% RH & 23° C)

Specimen A, a combination packaging (one 1-gal, friction plug metal can, in a grade V3c fiberboard box), was dropped from 1.8 meters onto the required four flat sides and the bottom manufacturer's joint corner. There was one small crease on the bottom seam of the can, and the center panel of the lid was slightly bulged. There was no noted leakage from or rupture of the can. The grooves of the lid were, for the most part, clean. There was no imbedded vermiculite. Upon examining the box, there was no leakage, rupture, or damage noted, except for minor crushing of the 5-2-3 corner. The can was retained completely within the box. The vermiculite had settled, approximately 1 inch.

It should be noted that five drops per box exceeds 49 CFR requirements. One drop per box is the **minimum** per 49 CFR *requirements* (49 CFR §178.603), as well as both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJII 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Materials. Also per this policy, any failed orientation(s) can be repeated using another configuration.

B. Stacking test: 49 CFR §178.606

☒ 24 hours ☐ days ☐ dynamic compression (periodic retest)
 at ☐ 23° C & 50% RH ☒ ambient ☐ 104° F conditions.

The empty box (specimen A) maintained the weight for the 24-hour time frame. The minimum top load to be applied was based on the anticipated gross packaged weight derived from the density of the heaviest liquid anticipated (SG = 2.7) at 98% of overflow capacity. Stacking stability was maintained. There was no visible damage sustained by the test box.

C. Vibration test: 49 CFR §178.608

As a means to determine capability, one packed box (specimen A), was tested for 60 minutes on a 1,250-lb vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak

Part 2. Test Results: Section III (continued)

displacement) such that the box was raised from the platform (liftoff) to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform. No apparent damage or distortion, as a result of this test at 3.4 Hertz (205 rpm), was visible upon inspection, except the filament-reinforced tape on the box bottom was abraded. The box and can remained closed, and the contents (can) were completely retained inside the box. The box was not opened before proceeding to the drop test. With the use of generic cans, it was not possible to evaluate whether any actual hazardous lading could leak from the can under conditions of repetitive-shock vibration. Per the supplier, these cans "are not recommended for solvents or other thin products".

D. Leakproofness test: 49 CFR §178.604

N/A. Leakproofness testing of inner packagings is not required.

E. Internal Pressure/Hydrostatic Pressure test: 49 CFR §178.605

N/A. Testing for the maintenance of internal pressure is not required for configurations intended for transportation by *surface modes*.

F. Water resistance (Cobb Method) test (fiberboard): As required by the standards for fiberboard boxes (49 CFR §178.516), the Cobb Method Test for water absorptiveness was performed on specimens cut from a box (specimen B) taken from the same bundle as the box used for rough handling (drop, stack, and vibration) testing.

No. specimens felt side (exterior) 5. Average 116.6 g/m².
Standard deviation 3.44. Highest exterior value was 120.0 g/m².
Lowest exterior value was 112 g/m². All of the samples tested were free of printing.

No. specimens wire side (interior) 5. Average 127.40 g/m².
Standard deviation 9.53. Highest interior value was 144.0 g/m².
Lowest interior value was 120.0 g/m².

No. specimens exceeding 155 g/m² 0.

It should be noted that improper storage and rough handling may break the fibers and abrade the coating of the box, decreasing its ability to resist water absorption. This could result in higher test values. Since boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings were tested for water absorptiveness.

Part 2. Test Results: Section III (continued)

G. Compatibility test (plastics packagings only): N/A.

The establishment of compatibility is a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii), and is only required for plastics packagings intended to contain liquid hazardous materials.

Section IV. Notes

This configuration is not applicable to the transportation of liquids by air. The intended modes of transportation are by surface (road, rail, and water) only. Combination packagings do not require leakproofness testing of the inner packagings. Combination packagings to be transported by surface modes (road, rail, water) do not require hydrostatic pressure testing of the inner packagings.

For this configuration, either firmly packed, fine grade vermiculite or firmly packed, "Absorbent GP" brand cellulose fiber absorbent can be used without any notable difference in performance. Inner packagings have a tendency to migrate if the loose fill material is not firmly packed.

The use of filament-reinforced tape as a means of banding, and as a secondary closure of the can, is required.

The use of the polyethylene top pad, tightly taped to the can top is required. The use of a polyethylene bottom pad, taped to the can is recommended.

Variation 4 for selective testing of combination packagings, found in 49 CFR §178.601(g)(4), authorizes each external dimension (length, width, and height) to be less than or equal to the corresponding dimension of the tested design type. This allows lessening of the dimensions to provide a snug fit around the packaging. The gross weight of the packaging must not exceed the tested weight, and the thickness of cushioning cannot be less than the thickness used in the tested configuration.

Part 3. Test Personnel

- A. Drop test** (49 CFR §178.603)
- B. Stacking test** (49 CFR §178.606)
- C. Vibration standard** (49 CFR §178.608 and §173.24a(a)(5))
- D. Leakproofness test** (49 CFR §178.604) - N/A
- E. Internal pressure/Hydrostatic pressure test**
(49 CFR §173.27 and §178.605) - N/A
- F. Water resistance standard** (49 CFR §178.516)
- G. Procedure for Testing Compatibility and Rate of Permeation
in Plastic Packaging and Receptacles**
(49 CFR §173.24, app B to part 173) - N/A

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

Part 4. References

- A. Title 49 Code of Federal Regulations, Parts 173 and 178,**
October 1, 1997 edition
- B. International Air Transport Association Dangerous Goods
Regulations,** 39th edition, 1 January 1998
- C. ASTM D 4919,** Specification for Testing of Hazardous
Materials Packagings
- D. ASTM D 999,** Standard Method for Vibration Testing of
Shipping Containers
- E. ASTM D 951,** Standard Test Method Water Resistance of
Shipping Containers by Spray Method
- F. TAPPI Standard: T 441** Water Absorptiveness of Sized (Non-
Bibulous) Paper and Paperboard (Cobb Test)
- G. Recommendations on the Transport of Dangerous Goods,** sixth
revised edition, United Nations, New York, 1990
- H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/
MCO 4030.40A,** Packaging of Hazardous Material, 23 Jul 96

Part 5. Equipment

Item	Manufacturer	Serial No.	Calibration
			Expiration Date
6-inch dial calipers	Brown & Sharp Switzerland	599-5794	1/03
1,250-lb vibration table	L.A.B Skaneateles, NY	8120179	see note
4,000-lb vibration table	Gaynes Engr. Co. Franklin Park, IL	G20765	see note
12,000-lb vibration table	M/RAD Woburn, MA	563-84	see note
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/00
5,000-lb compression tester	L.A.B Skaneateles, NY	1107050	4/00
10,000-lb scale	J.J. McIntyre & Sons Whitehall, PA	5931A	4/00
5,000-lb scale	Fairbanks Scale USA	H519240	4/00
500-lb scale	Toledo Scale Worthington, OH	N/A	4/00
5,000-gram scale	Ohaus Corporation USA	20078	N/A (new)
3,000-gram balance	Brinkmann Instruments Westbury, NY	3103120	4/00
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
drop tester	L.A.B Skaneateles, NY	3811	N/R
cold chamber	Russells Holland, MI	1962214	4/00
altitude chamber	American Research Corp. Farmington, CT	5A13622	4/00
32-channel chart recorder	Molytek, Inc. Pittsburgh, PA	870403007-2S	7/00
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R
30 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420001	4/00
100 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420002	4/00
torque wrench (150 ft.-lb)	Stanley-Proto Covington, GA	WWE30966	6/00
torque wrench (100 ft.-lb)	Stanley-Proto Covington, GA	WUK50305	7/00
torque wrench (50 in.-lb)	Stanley-Proto Covington, GA	5A98	N/A (new)
torque wrench (200 in.-lb)	Stanley-Proto Covington, GA	WYC22958	N/A (new)
400 kPa pressure gauge	Ashcroft Stratford, CT	45323-016A	11/00
400 kPa pressure gauge	Ashcroft Stratford, CT	5323-016B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59694-011B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59695-011A	11/00
semi-automatic plastic pail	Atlanta Grotnes	44833	N/A
Rieke® Flex Spout 600		15852	N/A

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Appendix A

Test Applicability

Based on the drop height and computed stacking weight, this test report is applicable for all **surface** modes of transportation including road, rail, and water, when the liquid hazardous substance intended for containment by the tested packaging is in accordance with the equivalencies listed in appendix B, section III of this report.

Transportation by air is not permitted unless the can has been certified and marked as being air eligible at the required pressure for the hazardous item. Appropriate packaging paragraphs apply.

Pass/fail conclusions were based on the particular box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings. It was not possible to identify the exact composition of the box construction materials.

Testing was performed per Title 49 Code of Federal Regulations, subpart M of part II.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the

Appendix A (Continued)

actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

The completion of successful recommended performance tests does not, by itself, authorize the marking and transportation of any dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of the performance testing completed and the dangerous good(s). Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration which simply uses the performance tested box. Packaging paragraphs apply.

Appendix B

Test Data Sheet

Section I. Test Product

Name: Water

Physical State: ☐ solid ☒ liquid ☐ gas ☐ aerosol

Amount Per Container (Configuration):

1 gallon (1 gal), rated

8.25 lb (8.25 lb)

9.0 lb (9.0 lb), packed

Gross Weight/Test Weight: 22 lb; 11 kg (Gross Weight = Test Weight x 2.205 lb/kg, rounded)

Density/Specific Gravity: 1.0

Consistency/Viscosity: N/A

Flash Point: N/A

Additional Description: N/A

Section II. Test Parameters

Drop Height: Ref: 49 CFR §178.603

☒ 1.8 m; 71 in. (PG I, II, & III, SG 1.2 or solids)

☐ 1.2 m; 47 in. (PG II & III, SG 1.2 or solids)

☐ 0.8 m; 32 in. (PG III, SG 1.2 or solids)

☐ m; in. (other, PG ☐, SG ☐)

from-- ☒ PG I: SG x 1.5 m, SG x 59.06 in.

☒ PG II: SG x 1.0 m, SG x 39.37 in.

☒ PG III: SG x 0.67 m, SG x 26.38 in.

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less. Equivalent specific gravity derived from drop height as follows--

PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

0.67 m x SG = 1.8 m, thus SG = 2.7, PG III

Appendix B (Continued)**Section II. Test Parameters (continued)****Stacking Weight Formula, Liquids - DLA**

Variables		Inputs	Calculations
h	height, drum/box	13	
n	# stacked containers	XXXXXXXXX	9.1
w1	weight, drum/box	2	2
w2	weight, bottle	0.77	0.77
w3	weight, ring/pad	0	0
q1	# inner containers	1	1
v1	max. volume, 1 inner container	1	1
v	total volume	XXXXXXXXX	1
w4	weight, gross packaging	22	22
W5	weight, absorbent	10	10
W	total weight	XXXXXXXXX	13
C	constant	1	
A1	Stacking weight-PG I	XXXXXXXXX	184.4
A2	Stacking weight-PG II	XXXXXXXXX	223.9
A3	Stacking weight-PG III	XXXXXXXXX	283.2
A11	Stacking weight, rounded-PG I	XXXXXXXXX	185
A21	Stacking weight, rounded-PG II	XXXXXXXXX	224
A31	Stacking weight, rounded-PG III	XXXXXXXXX	284

NOTE: A1 = $(n-1) \cdot [w + (1.2 \cdot v \cdot 8.3 \cdot 0.98) \cdot c]$, Packing Group I
A2 = $(n-1) \cdot [w + (1.8 \cdot v \cdot 8.3 \cdot 0.98) \cdot c]$, Packing Group II
A3 = $(n-1) \cdot [w + (2.7 \cdot v \cdot 8.3 \cdot 0.98) \cdot c]$, Packing Group III

A1 = stacking weight in pounds, PG I

A2 = stacking weight in pounds, PG II

A3 = stacking weight in pounds, PG III

n = $(118/h)$, minimum number of containers that when stacked, reach a height of 3 m

w = $w1 + (w2 \cdot q1) + (w3 \cdot q1)w5$, total weight in pounds

v = $v1 \cdot q1$, total volume

C = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing), or 1.0 (static top load)

Appendix B (Continued)

Section II. Test Parameters (continued)

Internal Pressure/Hydrostatic Pressure (liquids only):

Ref: 49 CFR §178.605 and §173.27

- X N/A; **surface only**
 [§178.605(a)]
- N/A; *solids*
 [§178.605(a)]
- 250 kPa (36 psi); *PG I single minimum*
 [§178.605(d)(3), surface & §173.27(c)(3)(ii), air]
- 100 kPa (15 psi); *PG II/III single minimum*
 [§178.605(d)(3), surface & §173.27(c)(3)(ii), air]
- 80 kPa (12 psi); *PG III of Class 3 or Division 6.1 sgl min.*
 [§173.27(c)(3)(ii), air]
- 95 kPa (14 psi); *inner/supplementary minimum, PG N/A*
 [§173.27(c)(2)(i), air]
- 75 kPa (11 psi); *inner/suppl. min., PG III of Cl 3/Div 6.1*
 [§173.27(c)(2)(i), air]
- 15 psi/103.4 kPa; *other, drum specification*
 [MIL-D-6054]
- kPa/ psi; *other, _____*

Appendix C

Packaging Data Sheet

Section I. Exterior Shipping Container

Packaging Category: ____ single X combination ____ composite

UN Type: Fiberboard boxes (49 CFR §178.516) UN Code: 4G

Specification Type(s):

- (1) Fabrication of Fiberboard Shipping Boxes
- (2) Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes
- (3) Box, Shipping, Fiberboard (canceled Mar 94)
- (4) Fiberboard: Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes (canceled Mar 94)

Specification Number(s):

- (1) ASTM D 5118, style RSC (regular slotted container)
- (2) ASTM D 4727 (marked), grade V3c (marked), type CF, variety SW, class (domestic/weather-resistant) not marked
- (3) Equivalent to-- PPP-B-636, style RSC [canceled Mar 94]
- (4) Equivalent to-- PPP-F-320E, type CF (corrugated fiberboard), variety SW (singlewall), grade V3c, class (domestic/weather-resistant) not marked, [canceled Mar 94]

Container Manufacturer:

Lynchburg Sheltered Industries Lynchburg Sheltered Industries
Lynchburg, VA (boxmaker's seal) Lynchburg, VA 24501 (box flap)

Date of Manufacture: 12-96 (marked)

Manufacturer's Reference Number(s): N/A

Material: Corrugated fiberboard, glued manufacturer's joint

"bursting test 350 lbs per sq inch"

"min comb wt facings 180 lbs per sq in"

"size limit 100 inches"

"gross wt lt 120 lbs"

"min. avg. burst. stgth. in excess of ____ lbs. p.s.i." - N/A

NSN: 8115-00-183-9491

Tare Weight: 2 lb

Dimensions: 12 in. by 12 in. by 12 in. ID (marked)

Appendix C (Continued)

Section I. Exterior Shipping Container (continued)

Box Contract No.: Not marked

Box Purchase Order No.: Not marked

Closure Specification(s): ASTM D 1974, Methods of Closing,
Sealing, and Reinforcing Fiberboard Shipping Containers

Closure Type: Pressure-sensitive, film-backed tape

Closure Type Specification(s):

- (1) Tested-- Commercial Item Description
Tape, Film, Pressure-Sensitive Adhesive, (Box Closure)
[canceled Dec 95]
- (2) Equivalent to-- FED SPEC
Tape: Packaging, Waterproof [canceled Dec 95]
- (3) Equivalent to-- ASTM Specification for Pressure-Sensitive
Tape for Packaging, Box Closure and Sealing

Closure Type Specification Number(s):

- (1) A-A-1830A (marked) [canceled Dec 95]
- (2) PPP-T-60, type III (film backing), class 2 (transparent)
[canceled Dec 95]
- (3) ASTM D 5486, type I (waterproof, weather-resistant,
polyester-backed), class 2 (transparent)

Closure Type NSN: 7510-00-266-6715

Closure Method: Tape applied over all seams, corners, and
joints of the box. Tape applied to the manufacturer's joint
shall cover the joint, but not extend beyond the corners. The
tape applied to the seams shall be centered over the seams and
shall extend over the corners and edges of the box a minimum
of 2½ inches onto the adjacent box panels.

Closure Method Specification: ASTM D 1974 *sealing method B*;
formerly method V, PPP-B-636 appendix (7-strip method)

Closure Dimensions: 2-inch (tape width)

Closure Manufacturer/Distributor:

American Tape	SETAPE, INC.
Secaucus, NJ (core marked)	Jacksonville, FL (wrapper marked)

Closure Contract No.: GS-141-63159 (box marked)

Appendix C (Continued)

Section I. Exterior Shipping Container (continued)

Closure Purchase Order No.: A-W-LE486-9E (box marked)

Closure Date of Manufacture: 2/97 (marked)

Reinforcement Type(s): Tape Banding

Reinforcement Specification(s) and Number(s): ASTM D 1974,
Methods of Closing, Sealing, and Reinforcing Fiberboard
Shipping Containers

Reinforcement Specification Method No(s): ASTM D 1974,
modified Reinforcement Method 2B (see Reinforcement Method)

Reinforcement Method(s): Tape applied 1 inch from each end of
the box. Bands shall overlap onto themselves at least
3 inches. Modifications-- 1-inch-wide tape used instead of
3/4-inch-wide tape; four bands instead of one band; medium
tensile tape used instead of high tensile tape

Banding Specification Type(s):

- (1) Tested (marked)-- Commercial Item Description
Tape, Pressure-Sensitive Adhesive, (Medium Tensile
Strength, Glass Filament, Reinforced Tape)
[canceled Jan 96]
- (2) Equivalent to-- FED SPEC
Tape, Packaging/Industrial, Filament Reinforced
[canceled Jan 96]
- (3) Equivalent to-- ASTM Standard Specification for
Pressure-Sensitive Tape for Packaging,
Filament-Reinforced

Banding Specification Number(s):

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile),
class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Banding NSN: 7510-00-582-4772

Appendix C (Continued)

Section I. Exterior Shipping Container (continued)

Banding Position(s): See Additional Description

- 2 girthwise tape bands, *encircling top, bottom, and sides*,
1 inch in from each end
- 2 lengthwise tape bands, *encircling top, bottom, and ends*,
1 inches in from each side
- 0 horizontal tape bands, *encircling sides and ends*,
centered around the box body

Banding Dimensions: 1 inch wide

Banding Manufacturer(s): RJM MFG./TARA TAPE (box marked)
TARA TAPE (wrapper marked)
Fairless Hills, PA 19030

Banding Contract No.: TC-GS-14F-63238

Banding Purchase Order No.: A-W-LC337-5E

Banding Date of Manufacture: 12/96 (box marked)

Cushioning/Dunnage: Vermiculite [approx. 10 lb]
polyethylene foam top pad [qty 1]

Cushioning/Dunnage Specification Type(s):

Vermiculite-- not identified

Note. Recommended use-- Commercial Item Description,
Vermiculite, Absorbent (For Packaging Liquid Hazardous
Material)

Fiberboard-- Standard Specification for Corrugated and Solid
Fiberboard Sheet Stock (Container Grade) and Cut
Shapes

Polyethylene foam-- Cushioning Material, Packaging,
Polyethylene Foam [canceled 28 Oct 97]

Cushioning/Dunnage Specification Number(s):

Vermiculite-- Not identified

Recommended use-- A-A-52450, NSN: 8135-01-324-2664

Fiberboard-- ASTM D 4727, type CF (corrugated fiberboard)
variety SW (singlewall), C flute
class WR (weather-resistant)
grade V3c

Appendix C (Continued)

Section I. Exterior Shipping Container (continued)

Cushioning/Dunnage Specification Number(s) (continued):

Polyethylene foam-- NSN 8135-00-397-2583
 PPP-C-1752 [canceled 28 Oct 97, replaced by A-A-59136]
 white color
 class 2 (general purpose plank material)
 type I (formerly stress range 0.2 - 2.0 psi)
 grade A (standard)

Cushioning/Dunnage Dimensions: see Additional Description

Vermiculite-- Grade 3, ASTM C 516
 Fiberboard-- 12 in. by 12 in.
 Polyethylene foam-- 6¾ in. by 6¾ in. by 1 in.

Cushioning/Dunnage Manufacturer(s):

Vermiculite-- Palmetto
 Fiberboard-- not identified
 Polyethylene foam-- American Excelsior Company
 Earth City, MO 63405

Additional Description:

a. Two inches of vermiculite was placed in the bottom of the bag. The can was placed on the vermiculite, and more vermiculite was then packed around and over the can. Two inches of vermiculite covered the padded can. Approximately three inches of vermiculite separated the can from the sides and ends of the box. **The vermiculite must be firmly packed into the box corners.**

b. Before closing, the box was "shaken down" to settle the absorbent material. Additional vermiculite was added, as necessary to make a tight pack.

c. The quantities of absorbent material DO NOT meet the guidelines for absorbent material (1.5 in. sides, 2.5 in. top/bottom) outlined in AFJMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19F/DLAM 4145.3, Preparing Hazardous Materials for Military Air Shipments.

d. Care must be exercised when selecting vermiculite to avoid introducing water or surfactants (treatments to reduce dust) into the package. Only untreated vermiculite should be used. The use of CID A-A-52450, Vermiculite, Absorbent (For Packaging Liquid Hazardous Materials) is recommended.

Appendix C (Continued)**Section I. Exterior Shipping Container (continued)**

e. Before cancellation, PPP-B-636 specified that *horizontal* reinforcing tape bands (*encircling the box sides and ends*), are not required when the box depth (height) is less than but not equal to 18 inches. Experience has demonstrated that glued manufacturers' joints have potential to fail if horizontal reinforcing tape banding is not applied.

f. Before cancellation, PPP-B-636 specified that one *girthwise* reinforcing tape band (*encircling the box top, bottom, and sides*), is required when the box length is less than but not equal to 20 inches. Two reinforcing tape bands in the girthwise direction were used per instructions from the requesting organization.

g. Before cancellation, PPP-B-636 specified that one *lengthwise* reinforcing tape band (*encircling the box top, bottom, and ends*), is required when the box width is greater than 9 inches and less than 18 inches. Two reinforcing tape bands in the lengthwise direction were used per instructions from the requesting organization.

h. ASTM D 1974 recommends that, when used, tape bands shall be placed around the girth (smallest circumference) of the box with at least one band for each 15 inches of box length.

i. Prior to 3 March 1994, PPP-B-636 specified the construction, closing, and reinforcing of fiberboard boxes, while PPP-F-320 specified the fiberboard. Both FED-SPECs have been canceled and replaced with ASTM documents. ASTM D 4727 is the specification for fiberboard; ASTM D 5118 is the practice for fabricating fiberboard boxes; and ASTM D 1974 is the practice for closing, sealing, and reinforcing fiberboard boxes. The three ASTM documents almost mirror the two FED SPECs with the most notable exception being that PPP-B-636 provided tables for when and what size reinforcement was to be specified. ASTM D 1974 does not recommend comparable reinforcements.

Appendix C (Continued)

**Section II. Inner Packaging of Combination Packaging
Applicable/~~Not applicable~~**

Quantity of Inner Containers: 1 Capacity: 1 gallon each

Specification Type and No(s): N/A NSN: N/A

Type: 1-gallon paint pail with metal hand bail, and DF lid
(distributor's description); friction plug (lid)

Manufacturer/Distributor: Freund Can Company
Chicago, Illinois 60620 (box marked)

Manufacturer/Distributor Part Number(s): can-- 1837
bail-- W80
lid-- 6632

Contract and Purchase No(s): Not marked

Material(s): Steel, tin plate

Date(s) of Manufacture: N/A

Tare Weight (empty can): 0.79 lb; 358 g

Filled Weight: 9.0 lb ea

Dimensions: 6½ in. - diameter (OD) [can body w/o handles]
7½ in. - height (OD)

Closure Type: Friction plug

Closure Specification and Number(s): N/A

Closure Dimensions: 5½ in. (opening)

Closure Manufacturer/Distributor and Part No(s):
Freund Can Company, P/N 6632

Secondary Closure: Filament-reinforced tape (1 pc)

Secondary Closure Specification(s):

- (1) Tested (marked)-- Commercial Item Description
Tape, Pressure-Sensitive Adhesive, (Medium Tensile
Strength, Glass Filament, Reinforced Tape)
[canceled Jan 96]

Appendix C (Continued)

Section II. Inner Packaging (continued)

- (2) Equivalent to-- FED SPEC
Tape, Packaging/Industrial, Filament Reinforced
[canceled Jan 96]
- (3) Equivalent to-- ASTM Standard Specification for
Pressure-Sensitive Tape for Packaging,
Filament-Reinforced

Secondary Closure Specification Number(s): NSN-- 7510-00-582-4772

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile),
class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Secondary Closure Dimensions: 1 inch wide

Secondary Closure Manufacturer(s):

RJM MFG./TARA TAPE (box marked)
TARA TAPE (wrapper marked)
Fairless Hills, PA 19030

Secondary Closure Contract No.: TC-GS-14F-63238

Secondary Closure Purchase Order No.: A-W-LC337-5E

Secondary Closure Date of Manufacture: 12/96 (box marked)

Cushioning/Dunnage Type: *see Appendix C, Section I*

Cushioning/Dunnage Specification Type and Number(s): N/A

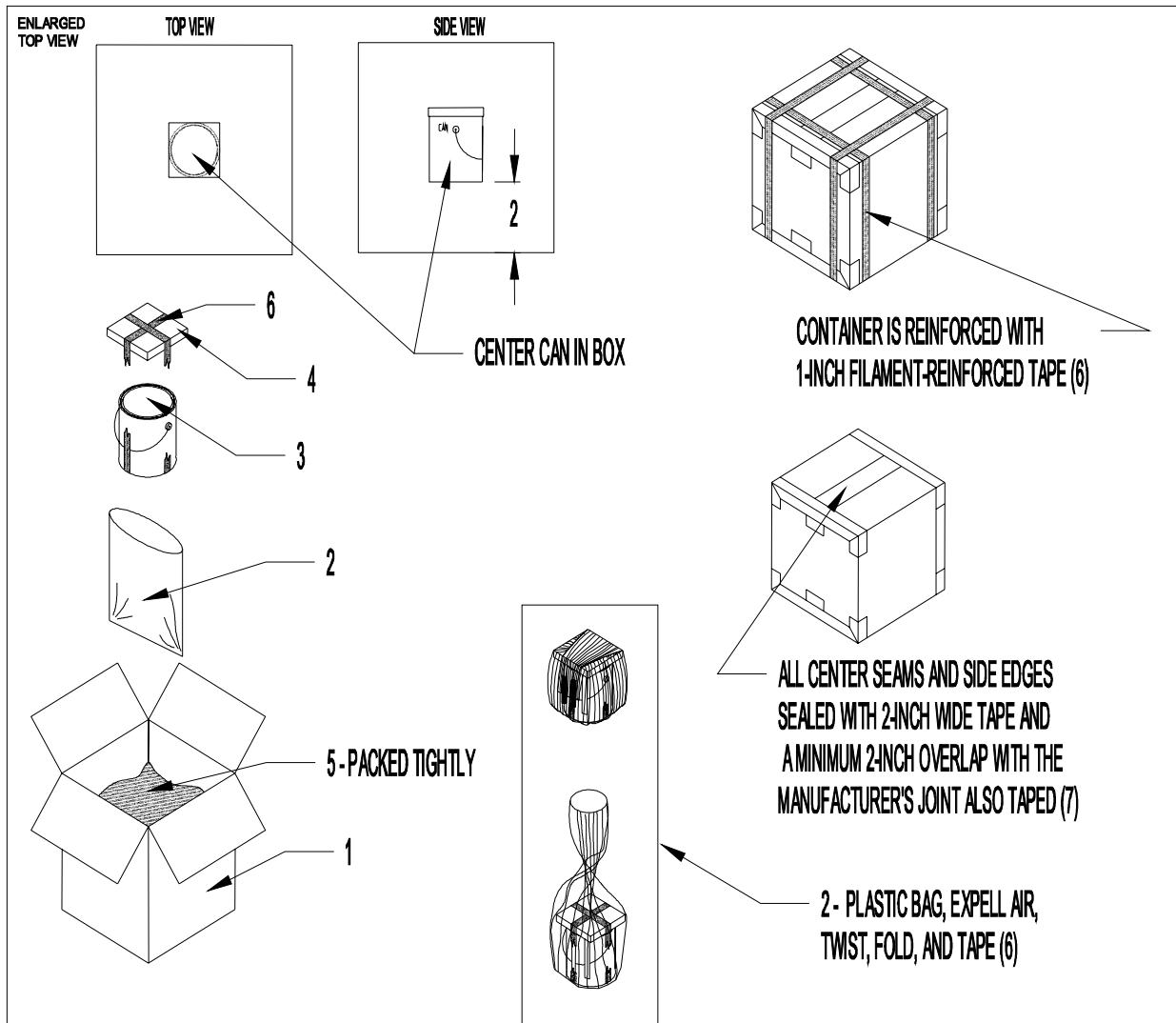
Cushioning/Dunnage Dimensions: N/A

Cushioning/Dunnage Manufacturer: N/A

Additional Description: A 1-inch thick, square polyethylene foam pad MUST be taped tightly to the top of the can, using two perpendicular strips of filament-reinforced, pressure-sensitive adhesive tape. One 1-inch wide tape must go over the handle, and each of the two strips must encircle the entire can. The length and width of the pad is equal to the diameter of the can.

Appendix C (Continued)
Section III. Drawing

RN 00AYP030



ITEM	DESCRIPTION	00AYP030D
1	FIBERBOARD BOX, ASTM D5118, STYLE RSC, GRADE V3c, NSN: 8115-00-183-9491, 12x12x12 IN.	
2	PLASTIC BAG, 4-MIL POLYETHYLENE	
3	1-GAL. PAINT CAN, QTY 1	
4	FOAM PAD, 1-INCH POLYETHYLENE, 7x7 IN.	
5	VERMICULITE, A-A-52450, OR CELLULOSE FIBER ABSORBENT	
6	1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D5330, TY II	
7	2-INCH WIDE, PRESSURE-SENSITIVE TAPE, PLASTIC BACKED, IAW ASTM D5486, TY I, CL 2	

Appendix D

Rationale

The equivalent of Packing Group I (great danger) testing was requested for a 12- by 12- by 12-inch corrugated fiberboard box having as the intended contents one 1-gallon, friction plug (lid), round, metal can. The can is more commonly known as a paint can. The configuration to be tested is intended to be applicable to a large assortment of liquid products contained in round, friction plug (paint), metal cans, in volumes of 1-gallon, 1-quart, 1-pint, or less. For lesser volumes, variations to testing requirements can be found in 49 CFR §178.601(g).

For testing, substitution for the actual hazardous lading is permitted by 49 CFR §178.602(c). Water can be used as a substitute liquid.

Vermiculite was used as an absorbent material and/or cushioning. Bands of pressure-sensitive adhesive, filament-reinforced tape were added to the exterior box, as necessary to reinforce the box in a standard manner for all fiberboard boxes, regardless of size. A plastic bag, tightly twisted, and securely taped, was used as a leakproof liner.

A secondary closure utilizing filament reinforced tape was used in accordance with accepted packaging practice. A polyethylene foam pad was tightly taped to the top of the can, as a means to secure the can lid in place, keep the vermiculite out of the grooves, and to protect the top of the can from bending or creasing.

One combination packaging made to the above described configuration was subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. Prior to the rough handling testing of the packed box, static loading was performed on the empty box. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications. A separate box was used for water absorptiveness testing of the fiberboard.

In conducting the drop test, all five drops (flat bottom, flat top, flat long side, flat short side, and manufacturer's joint bottom corner) were performed on the same configuration. The decision to use the same container (configuration) for all five drop

Appendix D (Continued)

orientations was based on the relatively minimal damage demonstrated during previous testing of grade V3c, class weather-resistant, corrugated fiberboard boxes with different inner containers. It should be noted that five drops per box exceeds 49 CFR requirements. One drop per box is the **minimum** per 49 CFR requirements (49 CFR §178.603(a)), as well as, per both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

Due to the variety of items to be packaged, testing was actually conducted according to the parameters for dense liquids (those with specific gravity up to 1.8) belonging to Packing Group II. This would equate to rough handling tests equivalent to those for Packing Group I for liquids having a specific gravity of 1.2 or less, and for Packing Group III liquids having specific gravity 2.7 or less.

For the drop test (49 CFR §178.603), a free fall drop table, set for 1.8 meters (71 in.), was used. The impact surface was the ½-inch steel impact plate of the table, which was bolted to the concrete floor.

For the stack test (49 CFR §178.606), a 500-lb steel plate was used as a static top load, because it could hold the load constant for the required 24-hour timeframe. The minimum total top load to be applied was computed based on the density of the heaviest liquid anticipated at 98% of maximum capacity, and the outer box height. The top load was to simulate a stack of identical packagings which might be stacked on the packaging during transport. The minimum height of the stack could not be less than 3 meters (118 in.), so the number of packagings (stack height minimum divided by assembled box height) had to be represented by an integer number, which had to be rounded up, without respect to which was the nearest whole number.

The leakproofness test (49 CFR §178.604) was not conducted on the box, because the box is an outer packaging of a combination packaging, and is not intended for the containment of liquids.

The leakproofness and hydrostatic pressure tests of the metal can are not required, because the can is an inner packaging in a combination packaging.

Appendix D (Continued)

The hydrostatic pressure test (49 CFR §178.605) is a test to be performed for single packagings, and is not required for inner packagings of combination packagings. For internal pressure requirements for inner packagings of combination packagings intended for transportation by aircraft, 49 CFR §173.27(c) applies. For combination packagings to be transported by air, if the inner packaging is not able to maintain the designated internal pressure (49 CFR §173.27(c)(3)(i)), the inner packagings may be packed in a supplementary packaging which does meet the pressure requirements. The assumption was that the inner containers (metal cans) would not maintain the minimum internal pressure of 95 kPa (14 psi) stipulated for liquids other than Packing Group III in Class 3 or Division 6.1 (49 CFR §173.27(c)(2)(i)), for which a minimum internal pressure of 75 kPa (11 psi) is required. Therefore, for transportation by aircraft, the configuration, as tested, would need to be overpacked in a supplemental packaging (e.g., a drum) which *must be capable of* withstanding without leakage an internal pressure as caused by changes in altitude and temperature during transportation aboard aircraft. To determine if the supplemental packaging is capable of maintaining the required pressure for the intended lading, the liquid contents need to be identified along with the associated vapor pressure at 50° C or 55° C. As the configuration being tested is a combination packaging, it is not subject to the single packaging hydrostatic pressure test (49 CFR §178.605) and marking requirements of 49 CFR §178.503(a)(5). More clearly stated, a hydrostatic pressure test of 250 kPa (36 psi) for liquids in Packing Group I is not applicable, unless 250 kPa is the pressure related to the vapor pressure of the liquid to be conveyed, as computed based on the vapor pressure of the lading at 50° C or 55° C.

As required by the standards for fiberboard boxes (49 CFR §178.516), the Cobb Method Test for water absorptiveness was performed on specimens cut from a box taken from the same bundle as the box used for rough handling (drop, stack, and vibration) testing. This test was performed per TAPPI Method T 441 om-90. The apparatus used was a commercially available Cobb Sizing Tester. The volume of deionized water was computed to maintain an equivalent head of 1.0 ± 0.1 centimeter. Since boxes are occasionally made with the wire facing (interior) as the exterior side of the box, specimens from both the wire (interior) and the felt (exterior) facings were tested for water absorptiveness. It should be noted that improper storage and rough handling can break the fibers and abrade the coating, decreasing the ability to resist water absorption. This could result in higher test values.

Appendix D (Continued)

The vibration test (49 *CFR* §178.608), utilizing a 1,250-lb capacity vibration table, was performed to be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 *CFR* §173.24a(a)(5)). The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). Testing was conducted as a means to determine capability. The test was run for 1 hour.

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 *CFR* §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain liquid hazardous materials.

